FCC NOTICE OF PROPOSED RULE MAKING
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Note: **Comments are made in general terms first followed by specific comments on the Rule Making which are indexed to paragraph numbers**

Background of Epsilon Lambda
Founded in 1974, Epsilon Lambda is focused exclusively on millimeter wave components, subsystems and systems. The company has performed industrial and government research for 20 years and industrial product development and manufacturing for 18 years. Epsilon Lambda was the exclusive developer and manufacturer of the 24.125 GHz radar subsystem which was installed on 1700 Greyhound buses by the Vorad company. The company has also supplied collision avoidance radar subsystems to European companies at 77 GHz and Japanese companies at 60 GHz.

GENERAL COMMENTS

1. Importance of the Rule Making.
The microwave industry in the US has developed and matured because the DOD invested in technology and then deployed many radar and communication systems. This is not true in Millimeter waves (above 30 GHz). The lack of FCC rule making above 40 GHz has also inhibited commercial development of systems. The proposed rule making removes a significant barrier for US companies to invest in commercializing systems. There are small pockets of millimeter wave technology in large and small US companies, mostly resulting from DOD system research, but the lack of DOD system deployment means there is no industrial manufacturing base for millimeter components and subsystems.

2. Commercialization Incentive
The emphasis in the Rule Making on Part 15 is very wise. Many low cost radar and communication short range applications are possible if licensing can be avoided. The FCC,

however, has not recognized an important difference between microwave and millimeter wavelength. The power limitations, use of small directive antennas and high absorption of energy means that there is a much smaller likelihood of mutual interference. As we will comment under paragraph 41 below, the restrictions on harmonic or spurious emissions must be dramatically relaxed above 40 GHz from those proposed, or the industry will be severely handicapped in its ability to develop hundreds of new, low cost radar and communications systems applications because the oscillators will be too complex and costly. Oscillator stability and spurious are the most difficult and costly producibility issues for a manufacturer. The huge spectrum and natural isolation available in millimeter wavelengths must be used to the cost advantage of the system and product designer if major new consumer markets are to be created.

3. Spread Spectrum Communications

The rule making neglected the very important new communications opportunity created by the FCC in its earlier approval under Part 15 (15.247) of the use of spread spectrum modulation to avoid interference in previously allocated bands. In the millimeter bands the same strategy can be employed to advantage with even less likelihood of interference because of the high atmospheric absorption.

It is necessary to allow low cost technology to evolve to the higher frequencies on a progressive basis. Therefore, under a separate discussion below, recommendations are given for introduction of three new bands for rule making involving unlicensed spread spectrum communications.

SPECIFIC COMMENTS

Proposed Rule Making

Par 6 With the pending approval of several new bands for automotive radar, it is not appropriate to allow continued proliferation of such devices in the 24.075 to 24.175 GHz band or the 24.675 to 24.775 GHz band. This allocation should be terminated within one or two years. These lower frequency bands are more useful for very low cost consumer applications such as the recently FCC authorized emergency vehicle safety radar in the 24.000 to 24.250 GHz band. If there are many collision warning radars on the roads, the safety radar concept for emergency vehicles will be undermined.

Par 16 The FCC logic is strongly endorsed. Vehicular radar should operate unlicensed under part 15 and in exclusive bands (which underscores the remark on Par 6 to remove them from 24 GHz).

Par 32 The FCC logic of designating these virgin bands for exclusive use by licensed and unlicensed services is endorsed. In accordance with remarks make in the General Comments above, and in the section below on Spread Spectrum, it would be also desirable to separate unlicensed bands into separate single frequency and spread spectrum portions. This was not possible in the previous decisions regarding spread spectrum, but is possible at the present time because of lack of previous rule making above 40 Ghz. As stated below, however, the consumer is best served in unlicensed spread spectrum allocation if very wide bands are allocated in order to provide the necessary data throughput for high speed wireless data communication.

Par 34 The FCC logic of temperature compliance of -20 to +50 degrees Celsius is endorsed. Any greater requirement would inhibit commercial growth because of added manufacturing cost.

Par 36 The FCC logic for type acceptance based on good engineering practice is endorsed.

Par 38-40 The FCC power limitation for Part 15 devices is appropriate only for narrow band modulation. The FCC must consider the need for higher total transmitted power for spread spectrum modulation. Safety standards for spread spectrum emissions must be established, but higher power spread spectrum modulation should not be precluded under Part 15 until such standards are available. As in the Part 15 spread spectrum rule making for 900 MHz, 2.4 GHz and 5 GHz, transmitter power of the order of one Watt will be required.

Par 41 The proposed spurious emission limitation of 2 picowatts/sqcm is very, very restrictive and will undermine the development of the low cost commercial products that the FCC is hoping to facilitate with the Rule Making. This standard would require spurious emissions to be down 72 dB for a transmitter at maximum allowed output. This is impractical for low cost commercial products. The FCC, in Paragraph 8, has already recognized the natural isolation which is prevalent in the millimeter spectrum due to space loss, atmospheric absorption and antenna directivity. For systems operating under Part 15 the spurious requirement should be reduced to 20 dB for second harmonic and 30 dB for spurious and higher harmonics. Any more restrictive requirement than this will increase the cost of transmitter technology to the point where low cost communication and radar systems will be denied to the consumer.

Par 42 The logic of voluntary industry standards for avoiding interference with government sources is endorsed. Information on standards or actual government emitters which is unclassified should be published and available to commercial equipment designers.

Par 44 Measurement practice above 40 GHz is not unlike that at lower frequency. Existing Part 15 requirements and good engineering practice should be followed.

Par 45 Consistent with remarks above on Par 41, the FCC should substantially relax its requirements, which are essential at lower frequencies, for measurement of harmonics in the millimeter wavelengths. For Part 15 transmitters in the 10 to 30 GHz range, measurements to the third harmonic are adequate. For Part 15 transmitters above 30 GHz, measurements to the third harmonic are adequate not to exceed 150 GHz. This requirement should remain relaxed until many millimeter wave systems are in use and evidence is produced to indicate interference problems. Again, an overly restrictive and conservative approach to the spurious emissions standards and measurements requirements will severely and unnecessarily hamper the rapid development of consumer products.

Par 47 The Part 15 power limitation of 30 microwatts/sqcm at three meters is adequate for collision warning systems having a range of about 500 ft.
The provision for peak power density outside of the main lobe of 200 nanowatts/sqcm at three meters is unduly restrictive and not necessary. This implies a sidelobe level of 22 dB which is difficult to obtain in some circumstances and may undermine desired antenna performance in other circumstances. The sidelobe level should be strictly an application driven feature. A minimum sidelobe level of perhaps 10 dB to mitigate against interference should be adequate.

Section 15.253(c)
(1) Does this imply that a vehicle radar cannot emit more than 200 nw/sqcm when it is stationary? This requirement seems to have no basis and would add major cost to the product.
(2) As stated under paragraph 41 above, the proposed harmonic and spurious specification of 2 picowatts/sqcm is severely restrictive and is not necessary in millimeter wavelengths. A more reasonable number is 2 nanowatts/sqcm for the second harmonic and 200 picowatts/sqcm for third harmonic and other spurious.

Spread Spectrum Communication
A major new communications industry is emerging based on unlicensed wireless local area networks (WLAN). This is the result of the FCC action during the 1980's to authorize three ISM bands for spread spectrum modulation. The first two of these, 902-928 MHz and 2400-2483.5 MHz are already experiencing important use and growth. As monolithic chip technology addresses the third band, 5725-5850 MHz, this will also become an important tool for product introduction and growth. One important limitation of these bands is the modest channel bandwidth and therefore limited data throughput. Wireless systems to be

commercially viable must compete in network speed with cable and fiber networks. Only then can the consumer elect for the convenience of wireless without sacrifice of network performance. The answer to this need is the bandwidth potential of the millimeter wavelengths. Since there is a delay of several years from the time that a rule making allows use of spectrum until the technology base allows low cost systems, it is imperative that the FCC address the allocation of spread spectrum in the millimeter bands very soon. The FCC in addressing frequencies of 40 GHz and higher must also consider this spread spectrum need in the range from 10 to 40 GHz.

Attached is a Table which shows the existing three ISM bands and three additional bands which Epsilon Lambda suggests for consideration. Two of the suggested bands are below 40 GHz. The reason for this is that technology must advance in reasonable increments. If the three bands are approved then those who manufacture and supply the sophisticated spread spectrum monolithic chips can begin the challenging process of development. There is no incentive to do this without the FCC spectrum approval.

The first suggested band is 24.000 to 24.250 GHz which is an existing ISM band. This band doubles the available spectrum available and therefore the potential network throughput. Availability of this band will expand the usefulness of WLAN systems and challenge the chip manufacturers to operate at much higher frequency than is now the case. The second suggested band is 37.000 to 39.500 GHz. This band provides major expansion of spectrum with additional challenge to the monolithic chip manufacturers. The third suggested band is one which is included in the proposed Rule Making, 59.000 to 64.000 GHz. The availability of 5GHz of spectrum allows very broadband, high speed WLAN "microcell" networks to compete with the best wired networks. Throughput of 25-100 MB/s will be possible with the suggested channel allocations shown in the attachment. Approval of these bands now will allow system and component suppliers to work together to achieve major advancement of WLAN systems.

Notice that as proposed in the attachment, the advancement from one band to the next permits significant improvement in channel bandwidth and spread spectrum processing gain. In order to compete with cable systems, these enhancements in performance are essential.

The FCC in its earlier Rule Making for Part 15 spread spectrum recognized the need to allow transmitter power of one Watt. That will be a requirement at higher frequencies also. The microcell networks will operate over 100 to 300 meters, and the one Watt of power is required to do this because of millimeter space loss.

It is therefore the suggestion of Epsilon Lambda Electronics Corp. that the FCC include Spread Spectrum Communications in the present Rule Making. If the Commission requires more time or more comprehensive input in order to address this matter, the undersigned will be pleased to cooperate.

Submitted Respectfully,

Epsilon Lambda Electronics Corp.

Robert M. Knox
President

	Existing ISM Band for Spread Spectrum Communications			*Proposed mmWave Band for Spread Spectrum Communications*		
[redacted]	0.915 +/- 0.013	2.44175 +/- 0.04175	5.80 +/- 0.062.5	24.125 +/- 0.125	38.25 +/- 1.25	61.50 +/- 2.5
[redacted]	0.026	0.083	0.125	0.25	2.50	5.00
[redacted]	30.00	30.00	30.00	30.00	30.00	30.00

*If transmitting antenna of directional gain greater than 6 dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Frequency Hopping Systems

[redacted]	50.00	75.00	75.00	100.00	300.00	400.00
[redacted]	0.50	1.00	1.00	2.00	5.00	10.00
[redacted]	25.00	25.00	25.00	50.00	75.00	75.00
[redacted]	0.60	0.40	0.40	0.20	0.10	0.75

Direct Sequence Systems

[redacted]	0.50	0.50	0.50	1.00	2.00	5.00
[redacted]	10.00	10.00	10.00	13.00	16.00	23.00
[redacted]	8.00	8.00	8.00	8.00	7.00	6.00